A "Fast" Localizer of Component Processes in Reading

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Introduction

Background

- Obtaining a snapshot of the reading circuit is highly useful
  - ▶Individual differences in neurobiology related to performance
- Limitations of previous localizers:
  - ▶Many involve metacognitive judgments
  - ▶Associated with long administration times

Aim

- To develop a localizer of the reading circuit that:
  - ▶Isolates regions involved in component processes
    - ▶*Orthography, phonology, semantics*
  - ▶Is sensitive to individual differences
  - ▶Requires little imaging time
  - ▶Is appropriate for different populations of readers

Methods

Subjects

- 18 adult monolingual English speakers (mean age 24; 11 F)
- Typical scores on standardized reading tests:
  - ▶Test of Word Reading Efficiency (TOWRE)
  - ▶Nelson-Denny reading comprehension

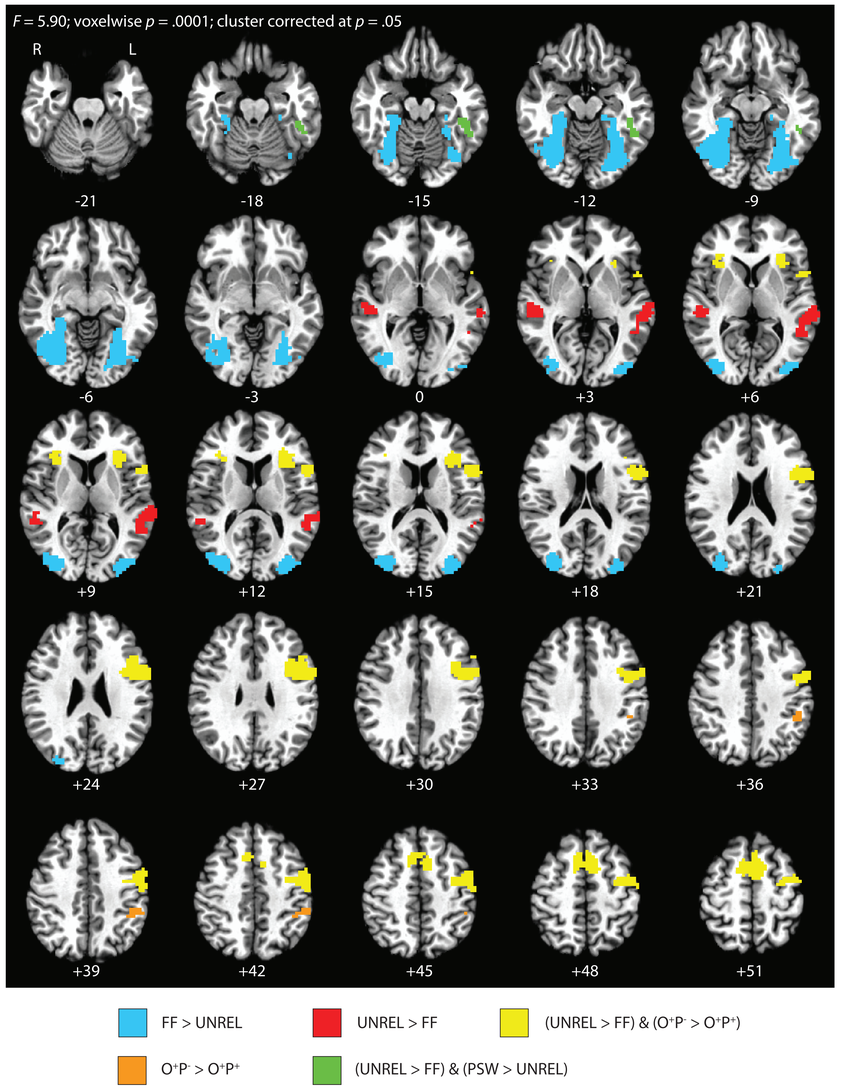
Procedure

- Rapid sequential presentation of sets of four items
- Six trial types:
  1. Unrelated (UNREL): CLAY / LAWN / FLEA / VASE
  2. O^+P^+: BEST / NEST / PEST / VEST
  3. O^+P^-: BOMB / TOMB / COMB / WOMB
  4. Semantically Related (SEM): FISH / BEEF / PORK / MEAT
  5. Pseudowords (PSW): JALL / PULE / TALM / WIBS
  6. False Font (FF): ♎◆♦♦ / ♐♋♋♊ / ⌘□□● / ⌘□♦♦
- Event-related design; four runs each 5:16 in length
- Administered a recognition memory test following each run
  - ▶Ensured subjects attended to the stimuli

Results: Groupwise Contrasts

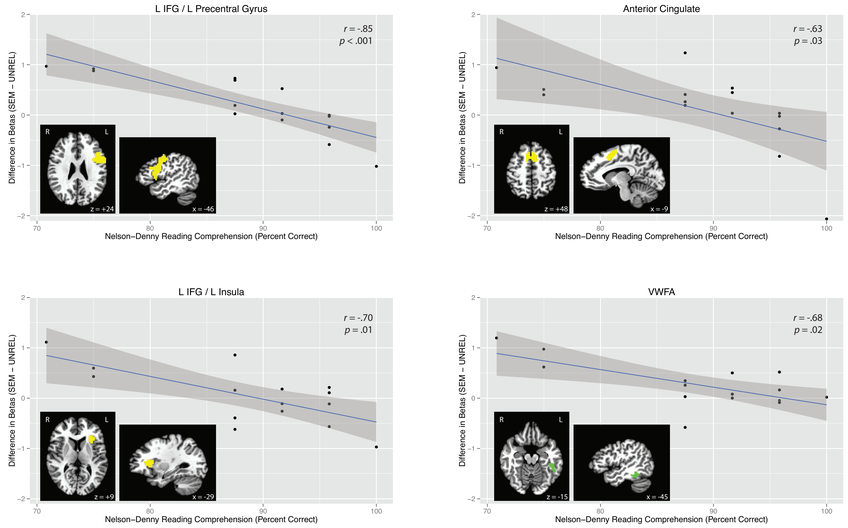
Key reading-related regions showed a main effect of stimulus type

Pairwise post-hoc t-tests revealed regions sensitive to component processes



Results: Brain-Behavior Correlations

Differences in activation between semantically related and unrelated words were negatively correlated with reading comprehension scores



Conclusions

Key Findings from a Group of Skilled Adult Readers

- Reliable isolation of brain regions sensitive to component processes of reading
  - ▶The VWFA was sensitive to lexicality
  - ▶Bilateral IFG and left SMG were sensitive to phonological consistency
- Sensitivity to individual differences
  - ▶Individuals with lower comprehension scores were more taxed by semantic similarity

Broader Significance

- The "fast" localizer offers several advantages over many previous protocols:
  - ▶Relatively brief amount of imaging time (~21 minutes)
  - ▶Does not require trial-wise responses
  - ▶Useful for individuals who may have deficits in response inhibition
    - ▶*e.g., children with reading disability and/or ADHD* (Willcutt et al., 2005, Dev. Neuropyschol.)

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